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APPROVED INSPECTION AUTHORITY

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OH0242

employment & labour
Department: Employment and Labour
REPUBLIC OF SOUTH AFRICA

OHAIA association
OHAIA-A 019 (2023)

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SAIOH

PRESENTATION TOPIC

Application of occupational hygiene principles in the commercial diving sector

TIME – 12:00 – 12:30

Occupational Health and Safety Act, 1993 – Section 8(1)

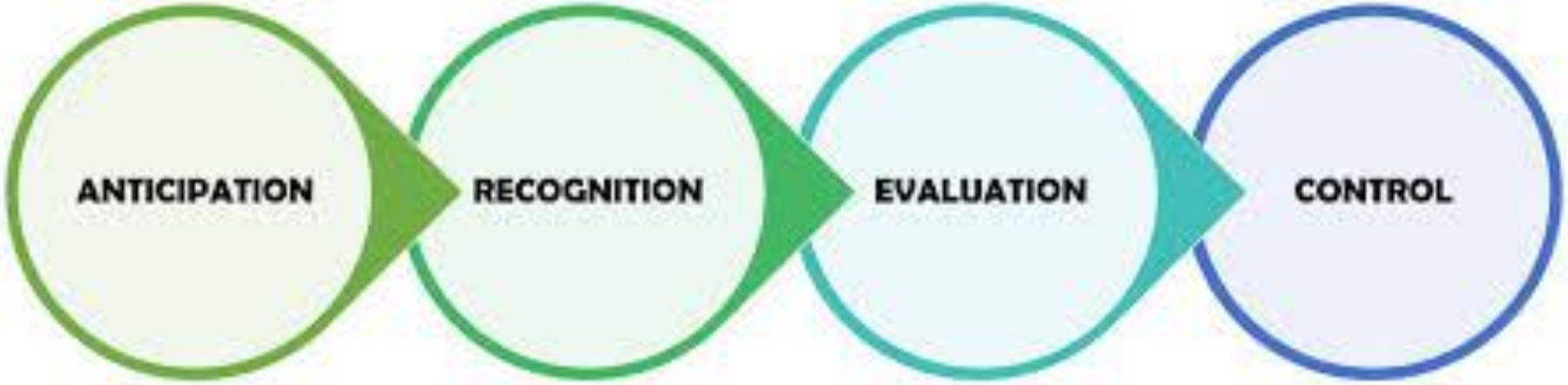
Every employer must provide and maintain, as far as is reasonably practicable, a working environment that is **safe** and with risk to the **health** of employees.

Occupational safety addresses potential safety hazards that can cause injury, whereas occupational health addresses potential health concerns.

What is occupational health?

- Occupational Hygiene
- Occupational Medicine
- Biological Monitoring

Principles



What is occupational hygiene?

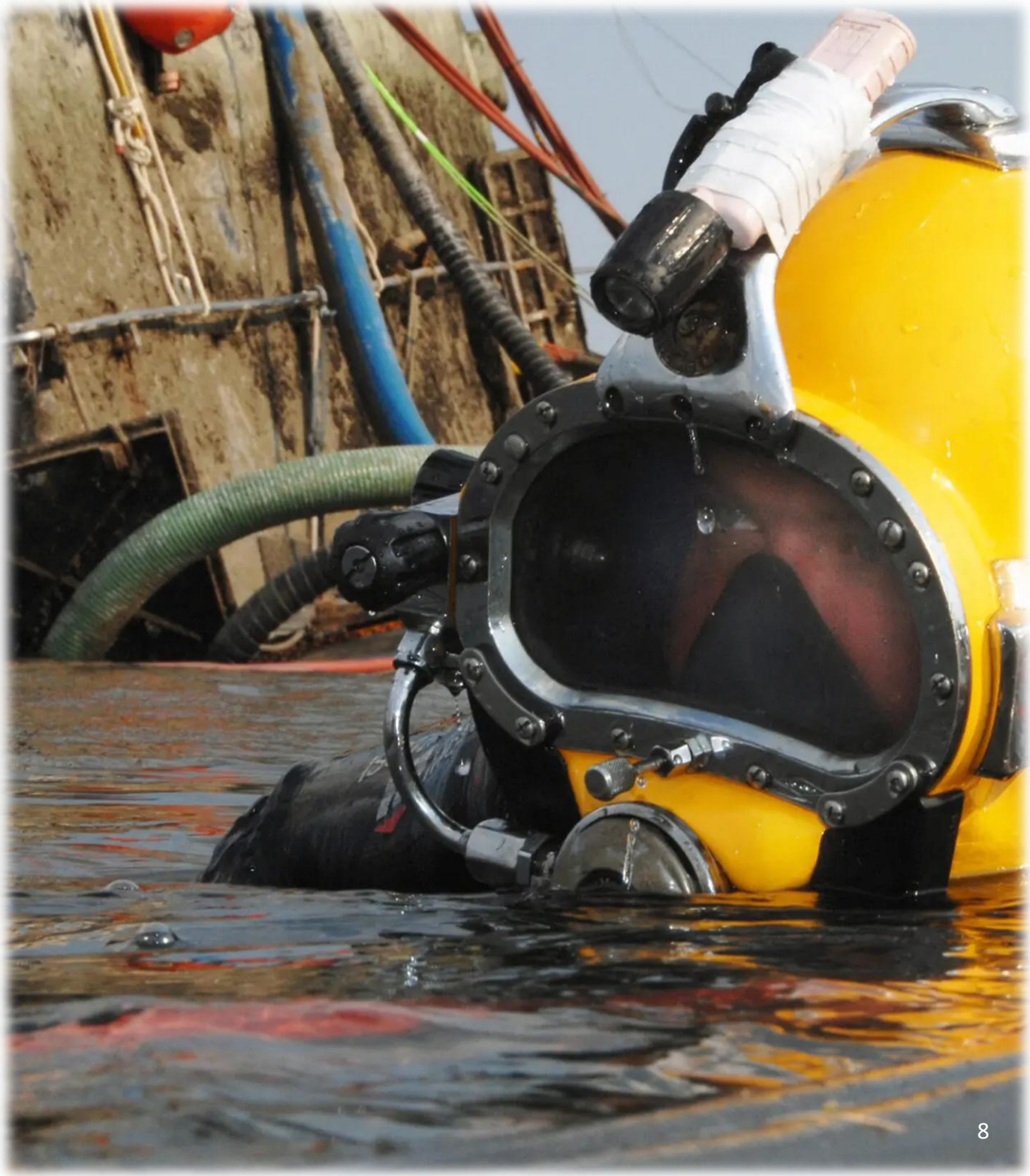
The International Occupational Hygiene Association (IOHA) refers to occupational hygiene as the discipline of anticipating, recognizing, evaluating and controlling **health hazards** in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large.

Occupational hygiene stressors (Health hazards)

Physical	Chemical	Biological	Ergonomic	Psychological
Noise	Gases	Bacteria	**Physical** ergonomics:	Excessive workload and overtime
Ionizing/Non-Ionizing radiation	Vapours	Viruses	• Work-related Upper Limb Disorders (WRULDs)	Shift work
Hand-arm and Whole-body vibration	Mists	Mould	• Manual Material Handling	Stress
Extreme temperatures (Cold / heat)	Dusts	Fungi	• Push / Pull activities	Challenging working environments
Illumination	Fumes	Human Edo-parasites	• Office ergonomics	Operating complex machinery/equipment
Extreme high / low air pressure	Liquids	Marine life	**Cognitive** ergonomics	
Water pressure differences	Fibres		**Organizational** ergonomics	

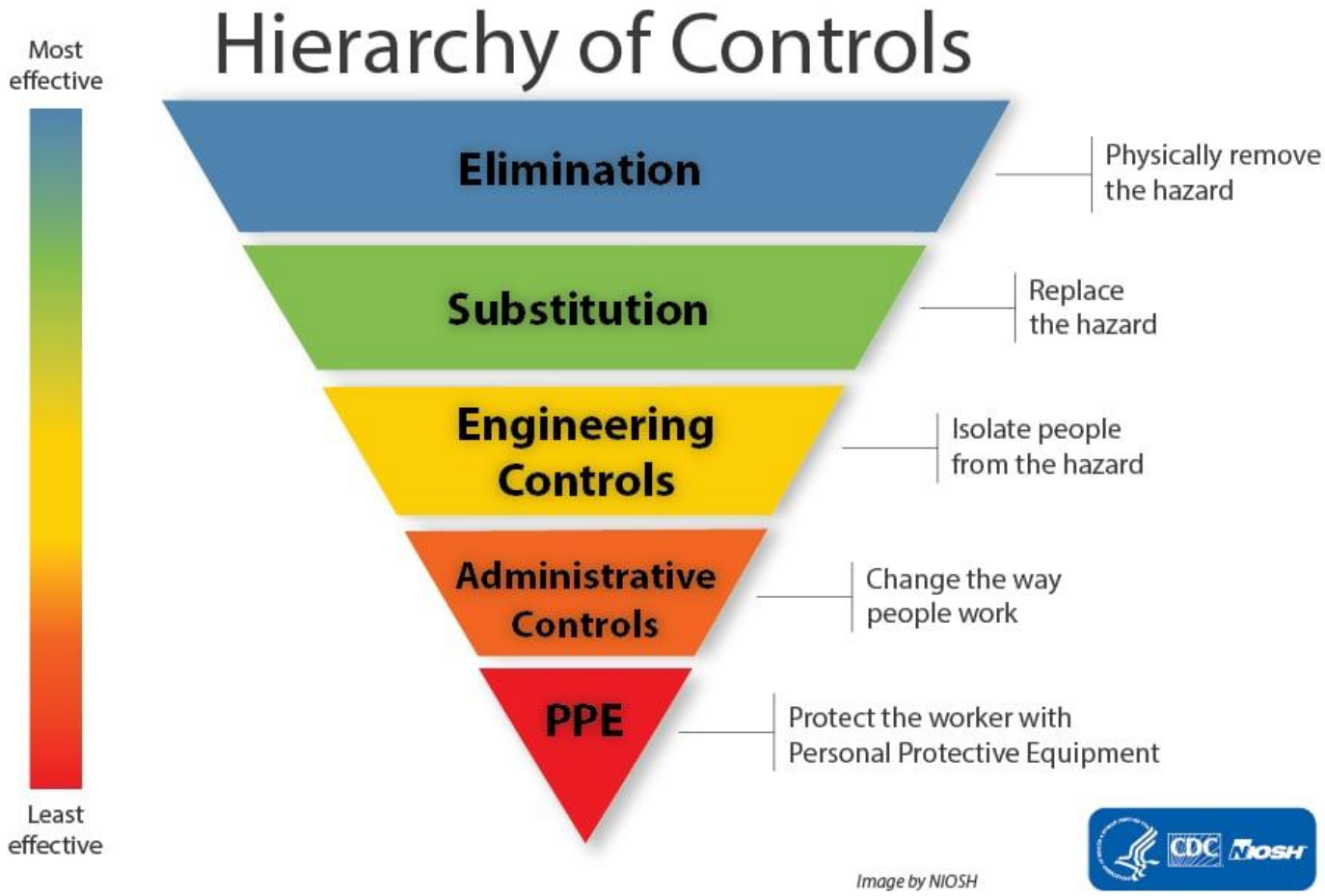
Anticipation - involves identifying potential hazards in the workplace before they are introduced. E.g., if diving in a sewer reactor must take place, we can anticipate that there will be numerous biological hazards present, zero visibility, zero buoyancy, etc.

Recognition - is the process of identifying potential hazards in a workplace. E.g., when arriving at a dive site you recognize (Identify) various hazards that was not anticipated, i.e., contaminated water, strong underwater currents, extreme cold-water temperatures, excessive noise from surrounding activities, low underwater visibility, etc.



Evaluation - is the process of identifying and assessing workplace risks to determine if they are within acceptable levels. E.g., taking a water sample and have it analyzed for the presence of E-coli, taking measurements of water temperature, etc.

Control - is an action taken to manage, reduce, or eliminate a workplace hazard or the risk of exposure to one



SOME EXAMPLES FROM EACH HEALTH HAZARD CATEGORY

NOISE EXPOSURE

CONTAMINATED BREATHING GASES SUPPLIED TO DIVER

EXPOSURE TO BIOLOGICAL HAZARDS IN A SEWER REACTOR

ERGONOMIC HAZARDS – DIVER INGRESS AND EGRESS FROM WATER

PSHYCHOLOGICAL STRESS DIVERS ARE FACING – HAZARDOUS WORKING ENVIRONMENTS

Physical hazard – noise

When noise is propagating in air, the noise level in dB is referenced at 20 µPa (the average human threshold of hearing at 1 kHz), and so noise levels are written as:

dB re. 20 µPa

Measurements expressed in this way describe the dB level of sound above the human hearing threshold. To account for the sensitivity of the human ear in air at different frequencies, an A weighted scale, denoted by dB(A) is used and indicates the way in which airborne noise is related to the human perception of sound.

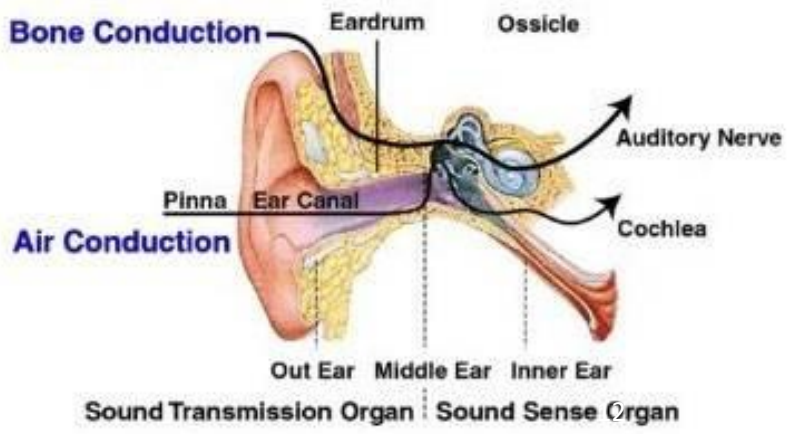
Noise underwater is very different than in air and is referenced to a pressure of:

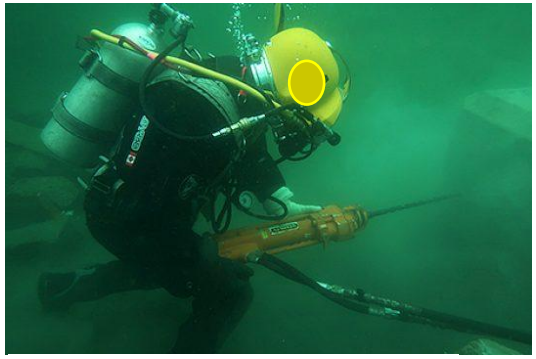
dB re. 1 µPa @ 1m

Airborne and underwater sound levels can be converted by adding or subtracting 26 dB

(Ref:-HSE RR735)
https://pdf4pro.com/view/prepared-by-qinetiq-for-the-health-and-safety-3a2d6.html

WET EAR
VS
DRY EAR

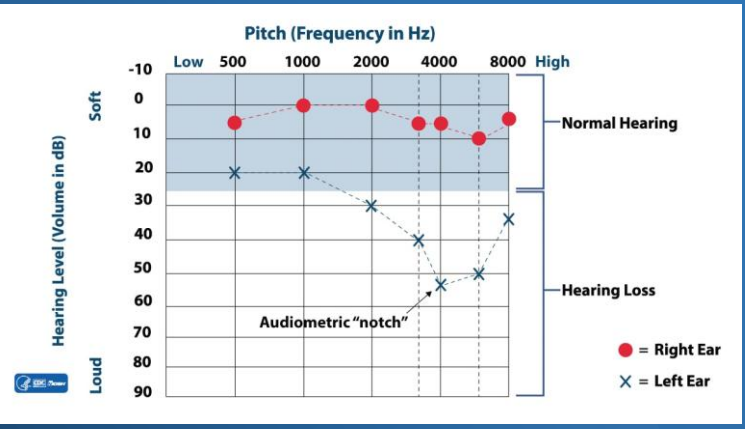




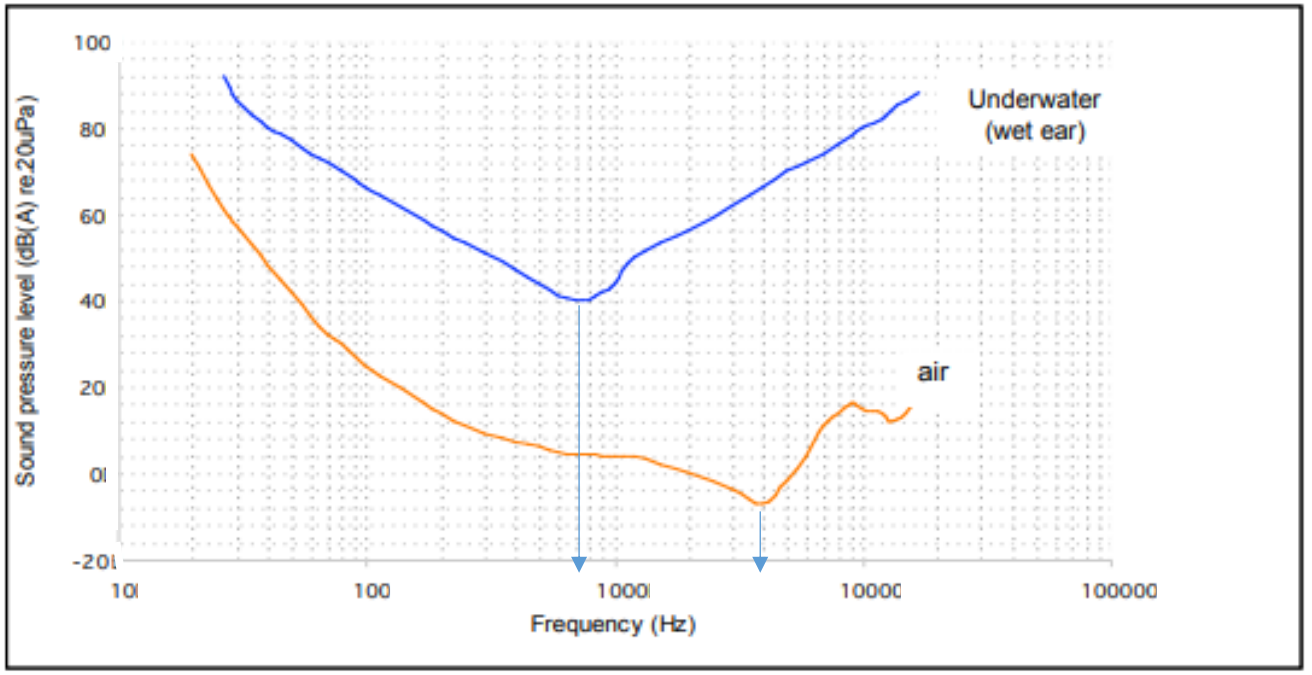
Source of noise	Source noise level (in water) dB re. 1 µPa @ 1 m	In helmet noise level (at divers ear) $L_{A,eq}$ dB(A) re. 20 µPa	Inside band-mask noise level (at divers ear) L_{eq} dB(UW) re. 20 µPa
Seismic survey air-gun [42]	240		
Concrete island drilling structure [51]	175		
3 underwater tools: pneumatic rock drill two different high-pressure water jet lances) [52]	Up to 170.5		
Three underwater bolt guns [53] - Ramset 200 HD - Hilti UW10 - Beto Tornado	 206.7 209.1 208.6		
Underwater stud gun (a Ramset 200 HD gun-powder actuated tool) [54]	211.4		
Butterworth 20K psi hydroblaster Hydraulic drill press Hydraulic impact drill Hydraulic grinder [7]		98.0 86.8 96.7 82.4	
Chainsaw (Stanley CS11) [6]	162	101.5	66.4
Disk grinder (Stanley GR24) [6]	158	111.0	65.6
Rock breaker (Stanley B67) [6]	180	112.6	70.1
Rock chipper (Stanley CH18) [6]	163	111.5	71.3
Hand drill (Stanley DL08) [6]	159	109.5	65.6
Impact wrench (Stanley IW16) [6]	167	107.7	67.0
Clucas 'Kerf cable' cutter [6]	163	107.9	69.5
Clucas 'oxy-arc' cutter [6]	148	100.7	63.6
Background level [6]		83	60

Table 4.4: Noise levels generated by underwater tools

Ref: RR735 HSE



Underwater auditory thresholds and frequency sensitivity



The human auditory system is most sensitive to waterborne sound at frequencies from 400 Hz to 1 kHz, with a peak at approximately 800 Hz. Hence, these frequencies have the greatest potential for damage. (Wet ear).

For airborne sound, hearing is most sensitive between 2 and 6 kHz, with a maximum sensitivity at approximately 4 kHz. However, underwater hearing is less sensitive at these frequencies, and so the noise hazard is reduced.

HEALTH HAZARD	HEALTH EFFECT	ELIMINATION	SUBSTITUTION	ENGINEERING	ADMINISTRATIVE	PPE
Excessive noise	Noise induced hearing loss (Permanent threshold shift)	Not possible	Make use of equipment and machinery that generate less noise. Use hydraulic instead of pneumatic tools	Reducing of diving site noise, e.g., fitting exhaust mufflers on internal combustion engines, fitting silencers to compressed air exhausts, etc. Helmet soundproofing – by incorporating acoustic insulation in and around the diving helmet shell.	(Obtain technical data specifying the noise output level of equipment from manufacturers). This applies to equipment for all aspects of diving operations including surface machinery (e.g. compressors), diving apparatus (e.g. diving helmets), diver tools and hyperbaric facilities (e.g. compression chambers). Medical surveillance – audiometric testing. Noise and hearing conservation training. Develop SOPs for work activities. Reduce exposure time, if possible. Conduct noise surveys.	Specialized hearing protectors for divers wearing helmets. 

Chemical hazard – contaminated air

SANS 10019:2023
Edition 9.1

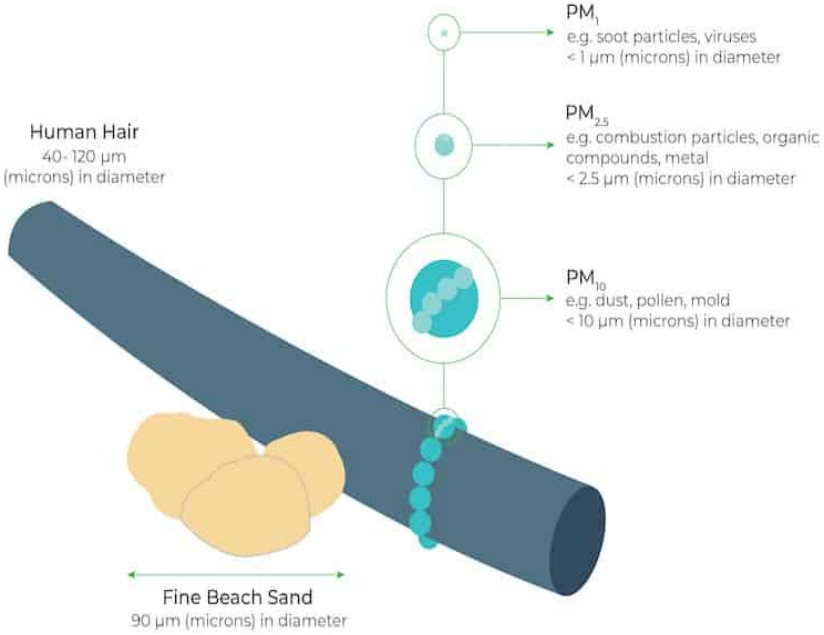


Table G.5 — Air quality requirements included on SANS 277

1	2
Contamination	**Accepted limits**
H_2O	≤ 50 mg m^{-3} for cylinders with a charging pressure up to 20 MPa
	≤ 35 mg m^{-3} for cylinders with a charging pressure greater than 20 MPa
	The water content of the air supplied by the compressor for filling 20 MPa or 30 MPa cylinders should not exceed 25 mg/m^{-3}.
Oil	< 0,5 mg m^{-3} (non-enriched, breathing air)
	< 0,1 mg m^{-3} [a] (oxygen-enriched breathing gas)
Particles[b]	< 0,5 mg m^{-3} Particles ≤ 5 microns
CO_2	A volume fraction of < 500 µg/g [≤ 500 ml m^{-3} (ppm)]
CO	A volume fraction of ≤ 5 µg/g [≤ 5 ml m^{-3} (ppm)]
Odour	The gas shall be free from unsatisfactory odour or taste
Notes:	Any appropriate analytical method should be employed as far as reasonably practicable for determining compliance with the limits For measuring and assessing results the accuracy of the method shall be taken into consideration. The following examples, but not limited to list below, of methods for assessing are: a) Hydrometer b) Dew-Point Meter c) Detector Tubes d) Gravimetric Analysis e) Microscopy f) Infrared Analyser g) Electrochemical Analyser h) Any advanced analytical instrument incorporating, for example PID (photoionization detector), MS-M-FID (mass spectrometry methaniser flame ionization detector), GC-MS (gas chromatography mass spectroscopy), paramagnetic sensor. i) Human Smell Sense j) Olfactometer The detection limit of the method employed shall be below the required limit value

a When a requirement for oxygen compatible air with a potential exposure to oxygen content >25 %/vol exists, or the filling of cylinders that is labelled for NITROX, TRIMIX, or OXYGEN CLEANED, the oil limit shall be < 0,1 mg/m³.

b Particles should be removed through inline mechanical filtration capable of achieving required results.

NOTE Where breathing gas is provided on a commercial basis evidence should be available where the tests on the system was performed at least twice in a 12 month period.

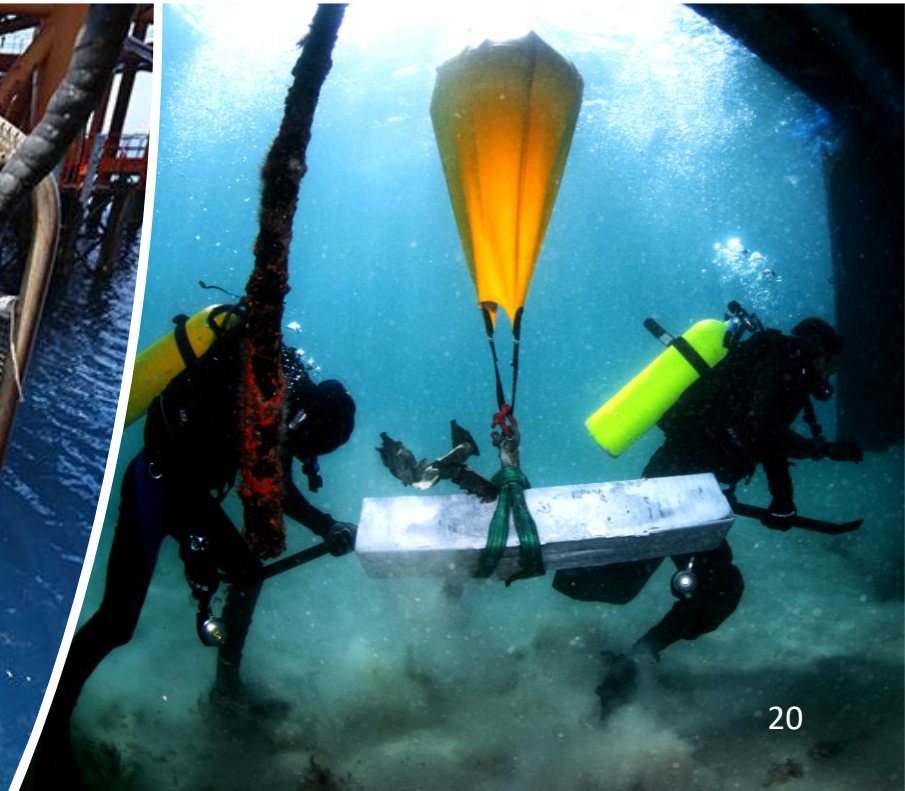
HEALTH HAZARD	HEALTH EFFECT	ELIMINATION	SUBSTITUTION	ENGINEERING	ADMINISTRATIVE	PPE
Contaminated breathing air supplied to diver – H2O, CO2, CO, Oil, Particles and Odours	Too much H2O – damage alveoli, disrupt the exchange of oxygen and carbon dioxide in the lungs. Too little H2O – Dry out the breathing passages, cause discomfort. CO2 toxicity – hypercarbia: nausea, vomiting, dizziness, headache, rapid breathing, flushing, confusion, seizures, & loss of consciousness. CO poisoning – Headache, dizziness, nausea, vomiting, shortness of breath, confusion, unconsciousness and eventually death. Particulate matter such as dust, metal particles and oil particulates can cause respiratory issues for divers.	Eliminate possible hazard sources, i.e., exhaust gases from vehicles / internal combustion (petrol/diesel) engines close by. Always keep air intake of compressor up-wind, away from sources of contamination.	Provide electrically powered motors for compressor, instead of internal combustion engines.	High quality oil and water separators fitted to compressors.	SOP for Air purity testing (Drager test kit) Testing to be conducted at least every 6 months – SANS 10019. Develop SOP for compressor operators. Provide training and competence in operating compressor, including the need for regular flushing of oil and water separators.	N/a

EXPOSURE TO BIOLOGICAL HAZARDS IN A SEWER REACTOR

HEALTH HAZARD	HEALTH EFFECT	ELIMINATION	SUBSTITUTION	ENGINEERING	ADMINISTRATIVE	PPE
Biological hazards in a sewer reactor: Viruses, bacteria, parasites.	Gastroenteritis, skin infections, Hepatitis A & B, Leptospirosis, other illnesses, i.e., lung infections and diseases associated with E-coli exposure. i.e., abdominal and pelvic infections, pneumonia, meningitis.	Not possible	Not possible	Not possible	Medical surveillance – Including vaccinations against Hepatitis A & B. SOPs for decontamination, not only for the diver, but surface equipment and personnel also.	Dry-suit Cut resistant gloves Positive pressure full-face mask.

Ergonomics

- Occupational Hygienists we will conduct baseline ergonomic risk assessments. If specialized assistance is needed, then the services of an Ergonomist can be acquired.



HEALTH HAZARD	HEALTH EFFECT	ELIMINATION	SUBSTITUTION	ENGINEERING	ADMINISTRATIVE	PPE
Ergonomic risks, i.e., diver entry and exit from water, handling heavy loads underwater.	Unsafe entry – jumping from quay side into water – strain on spinal cord. Awkward lifting of heavy items underwater, may result in possible musculoskeletal disorders.	Not possible.	Not possible.	Provide ladders. Lifting stages. Air bags.	Conduct ergonomics risk assessments at least two yearly of work activities, by a competent person. Make use of risk calculators for WRULDS, Push/Pull and Manual material handling activities. Develop SOP for work activities. Provide training to employees regarding ergonomic principles. Medical surveillance.	N/a

Psychological stressors

- Commercial diving is a high-risk occupation.
- Commercial diving schools must make sure that prospective divers are deemed competent when leaving the training facility.
- Not all learner divers have the skills to become commercial divers, and diving schools should play their part in this process and inform a learner diver such outcome.

Thank you